Climate Change and Greenhouse Gas Emissions Effects Consideration

Tamarack Grazing Allotment Management Plan

1 Introduction

As the topics of climate change and greenhouse gas emissions have become more prominent in both the media and political discussions there has been an escalating debate concerning how and to what degree these factors can or should be considered in the planning and analysis of Forest Service projects and activities. In response to this need for direction the former Chief of the Forest Service, Abigail R. Kimbell, established that, "as a science-based organization we need to be aware of [the challenges presented by climate change] and [consider it any time we make a decision regarding resource management…."

1.1 The Forest Service Strategic Framework for Responding to Climate Change

The *Forest Service Strategic Framework for Responding to Climate Change* states, "the Forest Service will need to build consideration of climate change into virtually all aspects of agency operations including consideration of life cycle analysis of activities" (p. 11). In addition, many of the recommendations included within Appendix 1 of the cited document would be addressed under a greenhouse gas NEPA effects analysis for proposed actions.

1.2 Climate Change Considerations in Project Level NEPA Analysis

The Deputy Chief's January 16, 2009 letter of direction transmitting the January 13, 2009, *Climate Change Considerations in Project Level NEPA Analysis,* applies general NEPA direction and regulation to the consideration of the appropriateness and degree of climate change and greenhouse gas emissions analysis for a given project. This guidance frames climate change analysis by discussing the answers to two fundamental challenges: how our management may influence climate change mainly through incremental changes to global pools of greenhouse gases and how climate change may affect our forests and grasslands.

1.3 Degree of Climate Change Effects Analysis for Forest Service Projects

When considering the appropriateness and degree of consideration of the effects of climate change and greenhouse gas emissions (or other potential direct, indirect and/or cumulative effects) within an analysis, two factors assist in the determination. According to CEQ's 40 CFR 1501.7, items 2 and 3, the scoping process, "Determine[s] the scope (§ 1508.25) and the significant issues to be analyzed in depth…and identifies "and eliminate[s] from detailed study the issues which are not significant, narrowing the discussion of these issues in the statement to a brief presentation of why they will not have a significant effect on the human environment…." In addition, CEQ's 40 CFR 1508.9, Item 3i indicates that an Environmental Assessment, "shall briefly provide sufficient evidence and analysis, including the environmental impacts of the proposed action and alternative(s), to determine whether to prepare either an EIS or a finding of no significant impact (FONSI)." Therefore, the degree of effects consideration needs to be "sufficient" to decide whether "significant impacts" occur.

1.4 Considering Magnitude, Duration, and Significance

When considering these impacts or effects, FSH 1909.15, section 15 indicates that the analysis should consider "the magnitude, duration, and significance of the changes", where, "'significance," as used in NEPA, requires considerations of both context and intensity…" (40 CFR 1508.27).

When specifically addressing the action of authorizing livestock grazing, interest groups commenting on these analyses have just begun to submit comments relative to greenhouse gas emissions associated with the production of livestock, and the effects of livestock grazing in the context of climate change. This expressed interest in these effects, in combination with a substantial amount of recent relevant reporting and research would indicate at a minimum a need to provide a sufficient consideration of the magnitude and duration of effects to make a significancy determination.

2 The Effects of Grazing on Soil Carbon and Greenhouse Gas Emissions

2.1 Agriculture and Forestry Practices

The *USDA Forest Service Strategic Framework for Responding to Climate Change* states the following:

> Agriculture and forestry practices may either contribute to, or remove greenhouse gases (GHGs) from the atmosphere. Agriculture and forestry have affected GHG levels in the atmosphere through cultivation and fertilization of soils, production of ruminant livestock, management of livestock manure, land use conversions, and fuel consumption. The primary GHG sources for agriculture are nitrous oxide (N_2O) emissions from cropped and grazed soils, methane (CH_4) emissions from ruminant livestock production and rice cultivation, and CH_4 and N_2O emissions from managed livestock waste. The management of cropped, grazed, and forestland has helped offset GHG emissions by promoting the biological uptake of carbon dioxide (CO_2) through the incorporation of carbon into biomass, wood products, and soils.
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> In the United States, agriculture accounted for close to seven percent of total GHG emissions, amounting to 7,260 teragrams (Tg) of carbon dioxide equivalents (Eq) in 2005 (EPA 2007). …After accounting for Carbon sequestration related to forestry, agricultural and forested lands in the U.S. were estimated to be a net sink of 306 Tg CO_2 Eq. …Livestock production is responsible for…about 22 percent (of the agricultural GHG emissions) from enteric fermentation, 10 percent from managed waste, and 18 percent from grazed lands. It should be noted that the estimates…are for emissions only, and do not account for carbon storage in agricultural soils and forests (USDA 2008).

2.1.1 Greenhouse Gas Emissions and Livestock Grazing

According to Schuman, Janzen, and Herrick, “grazing lands are estimated to contain 10 to 30 percent of the world’s soil organic carbon” (2002). While some studies have found limited to large reductions in soil carbon and increases in CO_2 flux associated with grazing (Haferkamp and Macneil 2004, Welker et al. 2004). Studies involving modeling and remotely sensed data indicate that proper grazing can improve ecosystem production as measured by soil carbon storage (Li, Liu, and Tan 2007; Steinfeld and Wassenaar 2007; Reeder et al. 2004; Schuman, Janzen, and Herrick 2002).

Additional studies similarly conclude that certain levels of grazing may even increase carbon sequestration (Hellquist et al. 2007; Derner, Boutton, and Briske 2006; Derner et al. 2005; LeCain et al. 2001; Ganjegunte et al. 2005; Manley et al. 1995; Reeder et al. 2004; Schuman, Janzen, and Herrick 2002). Several studies complement these findings because they indicate that light to moderate levels of grazing have no overall effect on total carbon sequestration (Hellquist et al. 2007; Ma XiuZhi et al. 2005, Ingram et al. 2008, Derner, Boutton, and Briske 2006, Stavi et al. 2008, Owensby, Ham, and Auen 2006, Shrestha, and Stahl 2008, Ingram et al. 2008). In fact, intensive rotational grazing appears to be a viable option for greenhouse gas (GHG) reduction and carbon sequestration credits (Bosch, Stephenson, Groover, and Hutchins 2008, Steiguer, Brown, and Thorpe 2008, NRCS 2006, Li, Liu, and Tan 2007, Ingram et al. 2008; Conant and Paustian 2000; Steiguer, Brown, and Thorpe 2008; Streater 2009; Sharrow 2008).

Initially, these findings seem inconsistent with the dual observations that desertification results in a net loss of carbon to the atmosphere and that the rate of desertification has been estimated to be higher for grazing land than for other land uses globally (Steinfeld and Wassenaar 2007, Asner et al. 2004). However, these observations need to be considered in the context that conversion of land use from cropping to grazing increases carbon sequestration (Conant and Paustian 2000, Derner et al. 2005, Sharrow 2008, EPA 2005, Schuman, Janzen, and Herrick 2002).

It can safely be asserted that there is tremendous variability in carbon storage and its response to grazing across different land types (Derner, Boutton, and Briske 2006; Henderson, Ellert, and Naeth 2004). The Northern Great Plains appears to have small potential as a carbon sink (Haferkamp and Macneil 2004). Alternately local research indicates that ungrazed sagebrush steppe sites were CO_2 sinks during the period they were measured (Svejcar et al. 2008). Management practices that maintain or improve the condition of plant associations appear to be consistent with maintaining the soil organic pool. (Henderson, Ellert, and Naeth 2004, Brown and Thorpe 2008, Sharrow 2008).

2.1.1.1 Free-Ranging Livestock vs. Livestock in Containment Facilities

Grazing leads to redistribution of carbon on the landscape (Stavi et al. 2008). It has been noted that livestock waste management represents a potential long-term soil carbon gain (Fellman et al. 2008). Free-ranging livestock deposit manure across the landscape resulting in aerobic decomposition. Aerobic decomposition of manure generates considerably less methane than does decomposition associated with stockpiling strategies employed in more concentrated livestock production strategies (Alberta Agriculture and Food Ag-Info Center, EPA 2005). This “in-effect” land application of manure also results in a buildup of soil carbon that decomposes much more slowly than occurs when composting (NRCS 2007).

2.1.2 Environmental Consequences

2.1.2.1 Alternative 1 (No Action)

Under Alternative 1, livestock grazing would no longer occur within the project area. However, although livestock grazing and associated impacts would no longer occur, there would still be an evolution of resource conditions because biophysical processes would continue to occur. The difference between this potential future condition and current conditions for any given portion of land would be dependent on the past level or degree of grazing influence across the landscape. The biophysical processes associated with the emission of GHGs related to livestock production tied to the project area would be altered. Livestock would no longer be authorized to graze within the project area, therefore, there would be no livestock in the project area to produce the methane (CH_4) that results from enteric fermentation (the digestive process by which cattle release methane into the air). The current management system whereby carbon is redistributed across the landscape would cease.

Overall, a similar or reduced level of carbon sequestration and soil carbon build up would be expected within the project area. Management practices that maintain or improve the condition of plant associations appear to be consistent with maintaining the soil organic pool (Henderson, Ellert, and Naeth 2004; Brown and Thorpe 2008; Sharrow 2008), improvement of vegetative conditions in riparian areas that are currently in less than satisfactory condition (see riparian vegetation section) would be expected to increase in their efficacy as carbon sinks.

Under this alternative, the disposition of the displaced livestock that have been grazing within the project area would ultimately determine the actual effect on GHG emissions. Unless these cattle were slaughtered or otherwise perished they would continue to produce CH_4 as a result of enteric fermentation.

Many scenarios for the disposition of these displaced livestock would be expected to produce more net GHG emissions than have been produced in the past. Three scenarios where this would be expected to be the case include:

1. Livestock are raised in containment: Under this scenario (most unlikely for a cow/calf operation), livestock would be raised in a feedlot-like environment. Under this scenario, the production of both CH_4 and nitrous oxide (NO_2) associated with the anaerobic decomposition of manure would be expected to be increased dramatically, while CH_4 associated with ruminant digestion would be expected to decrease due to a higher quality of feed.

2. Livestock are moved to private rangeland: Under this scenario, finding unallocated rangeland is unlikely, therefore increased stocking on currently allocated rangeland would be expected. There is potential for rangeland degradation associated

with increased stocking rates, which would result in a reduced ability to capture and sequester carbon from the atmosphere.

3. Livestock are moved to private irrigated land: Under this scenario, finding unallocated irrigated pasture is unlikely, so increasing stocking on currently allocated irrigated pasture would be expected. In order to avoid degradation of the irrigated pasture it would be expected that inputs of fertilizer and water would increase. In this case, the potential for the production of CH_4 and NO_2 is dramatically increased, although capture and sequestration of atmospheric carbon is also increased.

2.1.2.2 Alternatives 2 and 3

Alternative 2 is to continue the allotment's current management plan. Livestock levels would therefore not change under this alternative. Because Alternative 3 does not propose any changes to current management regarding the number of livestock grazed, the overall season of use, or allowable forage utilization, its effects would not differ from those of Alternative 2.

The Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: Synthesis Report, Summary for Policymakers* describes improved "grazing land management for increased soil carbon storage" as one of the "key mitigation technologies and practices currently commercially available." Therefore, the reduction of grazing impacts associated with Alternatives 2 and 3 could be categorized as both facilitated adaptation and mitigation relative to the October 2, 2008 *Forest Service Strategic Framework For Responding to Climate Change* because, as with Alternative 1, Alternatives 2 and 3 would improve vegetative conditions in riparian areas that are currently in less than satisfactory condition (see riparian vegetation section) and therefore, would be expected to increase their efficacy as carbon sinks.

Based on the information above it is evident that Alternatives 2 and 3 meet the Forest Service's mission and the described purpose and need for this project while enhancing the resilience and adaptive capacity of resources to the potential impacts of climate change (USDA 2008). Both Alternatives 2 and 3 incorporate an adaptive management approach that provides flexibility to address inherent uncertainty associated with the local effects of climate change.

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